

**Amendment and Response**

Applicant: Nelson T. Rotto

Serial No.: 09/893,199

Filed: June 27, 2001

Docket No.: 10277US01

Title: HOLOGRAPHIC PHOTOPOLYMER DATA RECORDING MEDIA, METHOD OF MANUFACTURE  
AND METHOD OF HOLOGRAPHICALLY READING, RECORDING AND STORING DATA

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**REMARKS**

This Amendment is responsive to the Office Action mailed May 14, 2003. Claims 6, 7, 15, 16, 23 and 24 have been cancelled. Claims 1-25 were rejected. With this Response, claims 1, 9, 10, 17, 18 and 25 have been amended. Claims 1-5, 8-14, 17-22, and 25 remain pending in the application and are presented for reconsideration and allowance.

**35 U.S.C. § 112 Rejection**

The Examiner has rejected claims 1-25 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Specifically, the Examiner has rejected the claims for the use of the term "binder". The Examiner states in paragraph 2 of the office action that this term refers to a fully formed polymer, whereas an in-situ reaction forms a polyurethane matrix. Applicant notes that, at page 11, the term is defined to mean a reaction product of a polyisocyanate and a polyol, but does not specify the location of the reaction. Data recording media contain the final reaction product after such precursors have reacted. For this reason, it is believed that the term "binder" is not limited to the addition of a fully formed polymer. However, as the Examiner prefers the use of the term "matrix" and has held that this change would not be an introduction of new matter, Applicant wishes to expedite prosecution of the claims, and therefore Applicant has amended claims 1, 9, 10, 17, 18 and 25 to use the term "matrix" in place of the term "binder" for the polyurethane reaction product formed in-situ. Applicant therefore respectfully requests that the Examiner withdraw the rejection under 35 U.S.C. §112, second paragraph.

**35 U.S.C. § 103 Rejections**

The Examiner has rejected claims 1-6, 15, 17-23 and 25 under 35 U.S.C. §103 as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850) and Chang '478. Applicant respectfully traverses the rejection for the claims as currently pending.

Applicant has amended claim 1 to include the recitation that the polyisocyanate is an aliphatic polyisocyanate comprising a dimer or trimer of an aliphatic diisocyanate, namely, 1,6-

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hexamethylene diisocyanate. Neither Dhar nor Ueda nor Chang discloses that such dimers or trimers would be advantageous to use in holographic media. In fact, Dhar discloses a variety of useful matrix precursors and prefers a mercaptan epoxy step polymerization. In Dhar, acceptable time frames are stated (page 5, lines 16-17) to be up to 300 minutes. In Ueda, aromatic secondary diisocyanates are preferred, and in paragraph 47, where 1,6 hexamethylene diisocyanate is mentioned, it is in a mixture of isocyanates which includes tolylene diisocyanate. Likewise, the triisocyanate mixture disclosed includes at least one aromatic diisocyanate. There is no disclosure that faster reaction would be provided by primary diisocyanates or that a faster reaction time would be desirable; rather weatherability is the focus of the selection process in this reference; see paragraphs 71 and 72. Chang, while acknowledging that primary diisocyanates react faster than secondary diisocyanates using the tin-lead catalysis of the day (1985) is directed to the development of catalysts and co-catalysts which can improve the reaction time of secondary and tertiary diisocyanates to make them useful in products previously only makeable with primary diisocyanates. While it might be obvious to try primary diisocyanates in the medium of Dhar, it would not be obvious to one skilled in the art that dimers and/or trimers of 1,6-hexamethylene diisocyanate would exhibit an excellent combination of high photosensitivity, reaction time and viscosity. Further, neither Dhar nor Ueda supply any motivation for trying to decrease the reaction time. Dhar's preferred time is under 200 minutes. All of the polyurethane precursors tested by Applicant including the poly(tetramethyl glycol) polyisocyanate having the isocyanate groups attached to secondary carbons polymerized in well under 200 minutes, with 70% of the isocyanate groups of the poly(tetramethyl glycol) reacting within 60 minutes.

Further, the Examiner did not reject former claim 7 under this rejection; by amending claim 1 to include the limitation of former claim 7, Applicant believes that the rejection no longer applies to the claims as currently pending. For these reasons, Applicant respectfully requests that the rejection of claims 1-6, 15, 17-23 and 25 under 35 U.S.C. §103 as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850) and Chang '478 be withdrawn.

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The Examiner has further rejected claims 1-6, 8-15, 17-23 and 25 under 35 U.S.C. §103(a) as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850) and Chang '478 combined with Keys et al. '152 and/or JP 06-282209.

Applicant disagrees that the addition of Keys et al. '152 and/or JP 06-282209 to the previous combination of references renders the claimed invention obvious. The Examiner states that Keys et al '152 and/or JP 06-282209 teach the use of halogenated acrylate monomers which have a high refractive index. Applicant respectfully disagrees that these references teach any use of the acrylate polymers with polyurethane matrices or polyurethane precursors. Keys teaches the use of ethylenically unsaturated monomers such as halogenated acrylate monomers in a photopolymeric film containing a mirror formed by a reflection hologram; however, there is no teaching of polyurethane precursors to form a matrix. The binder which serves as a matrix (column 4, lines 30-63) comprises a polymeric material such as polyvinyl butyral, polyvinyl acetate, etc. No in-situ formation of the binder is disclosed, no polyurethane matrices are disclosed, and certainly no specific diisocyanates are disclosed.

Further, it is believed that the monomers disclosed in Keys would not necessarily have the viscosity required by Applicant's claims. At column 5, line 33-44, it is stated that most of the useful monomers are liquids, but a few solids may be admixed into the liquids. No preferred viscosity is disclosed for such combinations. Further, Keys does not have the same structure and the holographic data recording media of the invention, and would not necessarily require the speed of reaction nor the viscosity required in structures according to the present invention. For all of these reasons, Applicant cannot agree that Key can be readily combined with the previous references to render obvious the use of halogenated acrylate monomers with polyurethane matrices such as those in the present invention.

Applicant also respectfully disagrees with the Examiner's combination of JP 06-282209 with the previous references. JP 06-282209 does not teach the use of such monomers with polyurethanes, but rather with polyesters. JP 06-282209 does not teach the use of halogenated acrylate monomers with aliphatic polyurethane diisocyanates which comprise dimers or trimers. Since JP 06-282209 does not disclose any polyurethane precursors used with such acrylate

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monomers to form polyurethane matrices, Applicant submits that the disclosure of this reference would not logically be combined with the previous references by one skilled in the art.

Further, the Examiner did not reject former claim 7 under this rejection; by amending claim 1 to include the limitation of claim 7, Applicant believes that the rejection no longer applies to the claims as currently pending. For these reasons, Applicant respectfully requests that the rejection of claims 1-6, 15, 17-23 and 25 under 35 U.S.C. §103 as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850), Chang '478 combined with Keys et al. '152 and/or JP 06-282209 be withdrawn.

The Examiner has further rejected claims 1-25 under 35 U.S.C. §103(a) as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850) and Chang '478 combined with Keys et al. '152 and/or JP 06-282209 and Nishio et al. '218 and/or Sommerfield et al. '998.

The Examiner has stated that Dhar discloses the formation of thick holographic recording media using two independent polymerization reactions which are compatible. The Examiner further states that Ueda and Chang disclose the use of various isocyanates, including 1,6-hexamethylene diisocyanate. The Examiner states that Chang discloses that it is known that primary aliphatic diisocyanates react faster than secondary or tertiary isocyanate. The Examiner states that it would have been obvious to one skilled in the art to modify the invention of example 1 of Dhar by using other polyisocyanate to result in a time savings on preparation.

As stated above, none of these references, not Dhar nor Ueda nor Chang disclose that such dimers or trimers would be advantageous to use in holographic media. Dhar discloses a variety of useful matrix precursors and prefers a mercaptan epoxy step polymerization. In Dhar, acceptable time frames are stated (page 5, lines 16-17) to be up to 300 minutes. In Ueda, aromatic secondary diisocyanates are preferred, and in paragraph 47, where 1,6 hexamethylene diisocyanate is mentioned, it is in a mixture of isocyanates which includes tolylene diisocyanate. Likewise, the triisocyanate mixture disclosed includes at least one aromatic diisocyanate. There is no disclosure that faster reaction would be provided by primary diisocyanates or that a faster reaction time would be desirable; rather weatherability is the focus of the selection process in

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this reference; see paragraphs 71 and 72. Chang, while acknowledging that primary diisocyanates react faster than secondary diisocyanates using the tin-lead catalysis of the day (1985) is directed to the development of catalysts and co-catalysts which can improve the reaction time of secondary and tertiary diisocyanates. While it might be obvious to try primary diisocyanates in the medium of Dhar, it would not be obvious to one skilled in the art that dimers and/or trimers of 1,6-hexamethylene diisocyanate would exhibit an excellent combination of high photosensitivity, reaction time, and viscosity. Further, neither Dhar nor Ueda supply any motivation for trying to improve the time of the reaction under the preferred time of 200 minutes. All of the polyurethane precursors tested by Applicant including the poly(tetramethyl glycol) polyisocyanate having the isocyanate groups attached to secondary carbons polymerized in well under 200 minutes, with 70% of the isocyanate groups of the poly(tetramethyl glycol) reacting within 60 minutes. So one skilled the art would have no motivation to combine the teaching of Chang that primary polydiisocyanates would provide a faster reaction by incorporating such materials into the holographic recording materials of Dhar and Ueda. Without motivation to combine the references, the combination claimed by the Examiner does not render the claimed invention obvious.

Also noted above, neither Keys nor JP 06-282209 disclose the use of halogenated acrylates with diisocyanates to form a matrix or binder. Neither Keys nor JP 06-282209 disclose dimers or trimers of 1,6-hexamethylene diisocyanate nor primary diisocyanates having specific viscosities. It would not be obvious to choose these specific polyurethane precursors having these viscosities along with the acrylates disclosed in Keys and JP 06-282209 to provide photopolymer data recording media which would polymerize between a capping layer and a substrate layer to have little or no gravity flow of the materials.

The Examiner states that Nishio et al. '218 ("Nishio") teaches biurets of hexamethylene diisocyanates as being preferred. However, Nishio teaches such biurets in the context of a totally different structure from that present in Dhar or Ueda or Applicant's claimed invention. The structure of Nishio is multilayered with a transparent resin layer (c) having a sheet form and cured resin composition layer (a) in an optical device. The isocyanates are taught as useful in a

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possible adhesive layer (b) which can be provided between the other layers, if needed. This is a separate layer, not a matrix layer for the photopolymeric layer. In Nishio the photopolymeric layer is a layer having no yield point, preferably comprising an epoxy acrylate, a non-functional acrylate, and a photoinitiator. Adhesive layer (b) is taught to be used when necessary for adhesion of the transparent resin layer and curable resin composition layer: see column 12, e.g., lines 59-64. There is no matrix formed in the transparent resin layer separate from the photopolymer such as that described in Dhar. One skilled in the art would not find it obvious to choose a polyurethane precursor listed as a preferred compound for use in an adhesive layer to use as a matrix in the photopolymeric functional layer. It would not be obvious to the skilled artisan to choose a material used for an entirely different function in a different layer of a multilayer device to use in a single layer device for a benefit which is not taught in the reference.

Because of this significant structural difference, and significant difference in the function of the polyurethane precursor in the device of Nishio, Applicant submits that it would not be obvious to combine Nishio with Dhar or Ueda.

The Examiner has stated that Sommerfield et al. '998 teaches the use of trimers of hexamethylene diisocyanates to form polymeric networks/matrices which include monomeric materials. Applicant respectfully disagrees with this characterization of the reference. Sommerfield et al. '998 discloses a type of interpenetrating polymer network (IPN) having at least two catenated polymer networks. Those networks may be comprised of any of a large variety of polymer systems, see column 11, line 44 through column 12, line 45. The networks include additional polymerizable monomers and photosensitive compositions. However, the trimers which the Examiner cites (column 21, lines 35-46) are not disclosed by Sommerfield as part of the IPN, but rather under the discussion of types of optional components. It is taught at column 20, lines 40 through column 21 line 46, that where the photopolymerizable composition is to be used as a permanent coating, a chemically or thermally activated crosslinking agent may be added to aid in the interlocking of the two networks and provide properties such as chemical resistivity. This is a conventional use of a polyisocyanate as a crosslinking agent for polymer networks and, in this case, the diisocyanate will assist in interlocking the two catenated polymer

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networks, and is not one of those networks. For this reason, Sommerfield et al '998 does not teach nor suggest, either alone or in combination with the other references, the use of dimers or trimers of 1,6 hexamethylene diisocyanate along with a polyol as a matrix to be polymerized around the additional polymerizable monomers. Therefore, it would not be obvious to one skilled in the art to use the crosslinking agents of this reference as the matrix in the device of Dhar or Ueda. It would not be obvious from this combination of references that the use of such dimers or trimers as the matrix would provide the benefits shown by Applicant, or indeed that the benefit of lessened time for the reaction of such a matrix would be desirable.

The Examiner has further rejected claims 1-25 under 35 U.S.C. §103(a) as being unpatentable over Dhar et al. (EP 0945762) in view of Ueda (JP 05-323850) and Chang '478 combined with Keys et al. '152 and/or JP 06-282209 and Nishio et al /218 and/or Sommerfield et al. '998 further in view of Kovar et al. 2002/0193460, Sugiyama et al. '086 or Mizuno et al. '147.

Applicant has argued above why the combination of the first references listed in this rejection would not render the claimed invention obvious. Applicant believes that the additional three references add nothing to the rejection.

Kovar discloses hexamethylene diisocyanates in the context of rapid reactions with vinyl dioxolane monomers, low volatility and production of low viscosity spray coatable vinyl dioxolane end-capped polyurethane oligomers. One skilled in the art would not believe this reference to be a predictor that such diisocyanates would cure rapidly without flowing prior to curing when injected between a substrate layer and a capping layer. In fact, since gravity flow is not desirable in Applicant's data recording media, the fact that use of these diisocyanates would produce a spray coatable composition would teach against the use in Applicant's application.

Sugiyama et al. '086 discloses a broad class of polyoxymethylene compositions for molding having improved heat stability. Several embodiments are disclosed, with each embodiment having a large list of possible ingredients for a total of many classes of chemicals, which are taught to be suitable to use in molding compositions. One embodiment of the composition (Formula IV) includes a thermoplastic polyurethane. A large class of isocyanates

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and derivatives are listed, including diisocyanates and dimers and trimers of the listed compounds. Such compounds are stated to be preferable for reasons related to coloration and handling safety considerations. Applicant believes that there is no reason why a skilled artisan would refer to such a non-analogous reference such to determine what diisocyanates would be useful in photopolymer data recording media, and what viscosities, and curing rates those diisocyanates would have in the context of such an application. Applicant further argues that the vast array of chemical choices in Sugiyama would require extensive testing to choose specific ingredients from those listed. It would not be obvious for a skilled artisan formulating an unrelated product to choose the specific dimers and trimers of the claimed diisocyanate and combine them to form a matrix in which ethylenically unsaturated monomers would be imaged holographically. Without knowledge of Applicant's specification, the skilled artisan would not go through the wide variety and choose only those compounds used by Applicant.

Mizuno et al discloses a reaction-injected urethane foam. While aliphatic isocyanates are disclosed, and dimers and trimers are disclosed as being non-yellowing, there is no reason why a skilled artisan would refer to such a non-analogous reference such to determine what isocyanates would be useful in photopolymer data recording media.

In fact, Applicant disagrees that these additional references add to the previous rejection. At most, the extra three references teach that related isocyanate compounds have properties that make them useful in foams, molds, spray-coatings and the like.

Applicant would note that the two rejections which apply to the claims as currently pending have 8 and 11 references, respectively, with each reference or pair of references identifying only certain aspects of the claimed invention. It is believed that the very number of references teaches against the obviousness of the claimed invention, as the skilled artisan would not be able to choose the dimers and/or trimers of 1,6-hexamethylene diisocyanate with the appropriate viscosities from all the disclosures of the many references without either extended testing of a wide variety of recommended chemical classes, or knowledge of Applicant's invention. Further, one skilled in the art would not expect that chemicals useful in e.g., molding applications, would be beneficial when used as in the data recording media application.

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Finally, Applicant believes that it would not be obvious to one skilled in the art to pick and choose the specific actinic monomers, diisocyanates, photoinitiators used by Applicant without the benefit of hindsight, using Applicant's application. Each of these references have differing combinations or lists of combinations, some have different applications, and the differing benefits. Without excessive testing, one skilled in the art would not pick the combinations claimed by Applicant. The excessive testing required to pick the specific components means that such combination would not be obvious to the skilled artisan, unless that skilled artisan had the benefit of Applicant's disclosure. At most, some of the combinations might be obvious to try, which is not the standard of 35 U.S.C. §103(a).

**Allowable Subject Matter**

In light of the above, Applicant believes independent claims 1, 10, and 18, and the claims depending therefrom, are in condition for allowance. Allowance of these claims is respectfully requested.

**CONCLUSION**

It is believed that all claims are now in a condition for allowance. Notice to that effect is respectfully requested.

The Examiner is invited to contact the Applicant's Representative at the below-listed telephone number if there are any questions regarding this response.

Respectfully submitted,

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